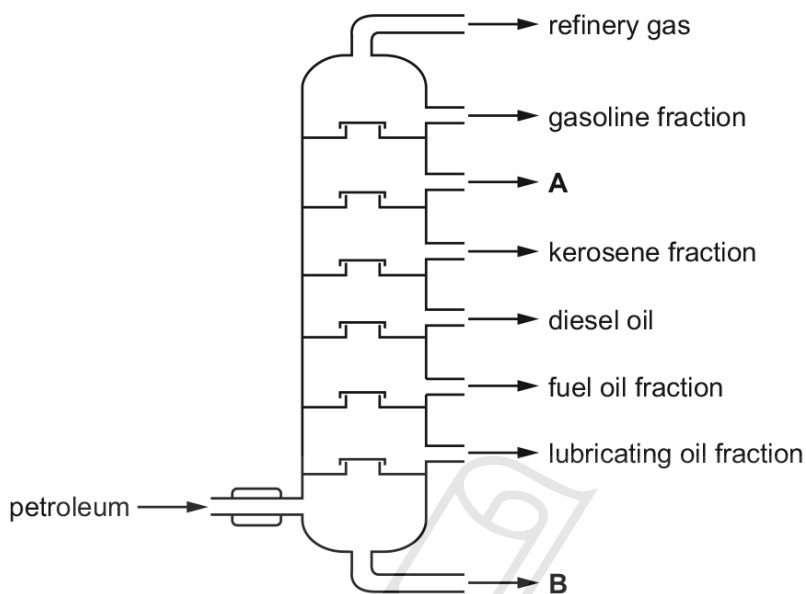


01. 0620_m20_qp_42 Q: 1

Petroleum is a useful natural resource.

The diagram shows how petroleum can be separated into useful substances.



(a) What is the name of the separation process shown in the diagram?

..... [2]

(b) Name the fraction leaving at:

A

B

[2]

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(c) Refinery gas is a mixture of hydrocarbons.

One refinery gas is butane, C_4H_{10} .

(i) Suggest the names of **two** other refinery gases.

..... and [2]

(ii) Write the chemical equation for the complete combustion of butane.

..... [2]

(iii) Name the toxic gas produced by the incomplete combustion of butane.

..... [1]

14.2. FUELS

(d) Gasoline and kerosene are both fuels. They have different properties.

(i) Describe the differences in the properties given.

viscosity of the fuel

.....

flammability of the fuel

.....

[2]

(ii) What difference in the molecules of gasoline and kerosene causes these differences in properties?

..... [1]

(e) Hydrogen fuel cells can be used to power vehicles.

Write the word equation for the overall reaction that takes place in a hydrogen fuel cell.

..... [1]

[Total: 13]



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02. 0620_s19_qp_42 Q: 1

The names of eight substances are given.

aluminium oxide	calcium oxide	ethanol	nitrogen
iron(III) oxide	methane	oxygen	silicon(IV) oxide

Answer the following questions about these substances.

Each substance may be used once, more than once or not at all.

State which substance is:

(a) the main constituent of natural gas

..... [1]

(b) a reactant in respiration

..... [1]

(c) the main constituent of bauxite

..... [1]

(d) a product of photosynthesis

..... [1]

(e) a greenhouse gas

..... [1]

(f) a macromolecular solid.

..... [1]

[Total: 6]

14.2. FUELS

03.0620_m18_qp_42 Q: 1

This question is about gases.

(a) The following substances are gases at room temperature.

letter	A	B	C	D	E	F	G	H
substance	SO ₂	Ar	CO	Cl ₂	NH ₃	CO ₂	CH ₄	C ₃ H ₈

Identify, by letter:

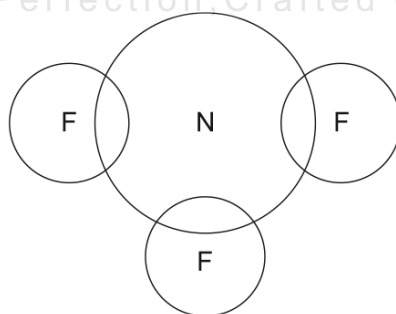
- (i) a gas which combines with water to form acid rain [1]
- (ii) two gases which exist as diatomic molecules [2]
- (iii) a gas which bleaches damp litmus paper [1]
- (iv) a gas which is used as an inert atmosphere in lamps [1]
- (v) two gases which are found in clean dry air [2]
- (vi) two gases which are found in refinery gas [2]

(b) NF₃ has covalent bonds.

(i) What is a covalent bond?

.....
 [2]

(ii) Complete the dot-and-cross diagram to show the electron arrangement in a molecule of NF₃.
 Show outer shell electrons only.



[3]

(c) Air is a mixture. Nitrogen and oxygen are the two most common gases in air.

(i) What is meant by the term *mixture*?

.....
..... [1]

(ii) State the percentage of oxygen, to the nearest whole number, in clean dry air.

..... [1]

(iii) Describe the steps in the industrial process which enables nitrogen and oxygen to be separated from clean dry air.

Use scientific terms in your answer.

.....
.....
.....
.....
.....
.....
.....
.....
.....
..... [3]

(iv) Which physical property of nitrogen and oxygen allows them to be separated?

..... [1]

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[Total: 20]

14.2. FUELS

04.0620_s18_qp_42 Q: 1

Give the name of the process that is used:

(a) to obtain water from aqueous sodium chloride

..... [1]

(b) to produce lead from molten lead(II) bromide

..... [1]

(c) to separate an insoluble solid from a liquid

..... [1]

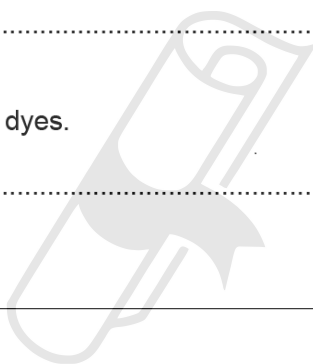
(d) to separate the components of petroleum

..... [1]

(e) to separate a mixture of coloured dyes.

..... [1]

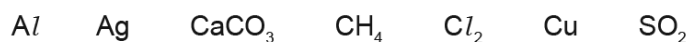
[Total: 5]



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05. 0620_w18_qp_41 Q: 1

The following formulae represent different substances.



Answer the following questions using only these substances.

Each substance may be used once, more than once or not at all.

State which substance is:

- (a) used to make food containers [1]
- (b) added to a blast furnace to remove impurities during the production of iron [1]
- (c) the main constituent of natural gas [1]
- (d) a cause of acid rain [1]
- (e) a gas which bleaches damp litmus paper [1]
- (f) a gas which contributes to climate change. [1]

[Total: 6]

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14.2. FUELS

06.0620_s15_qp_31 Q: 1

(a) Coal is a solid fossil fuel.

Name **two** other fossil fuels.

..... [2]

(b) Two of the elements present in a sample of coal are carbon and sulfur.

A sample of coal was heated in the absence of air and the products included water, ammonia and hydrocarbons.

Name **three** other elements present in this sample of coal.

..... [2]

(c) Sulfur, present in coal, is one major cause of acid rain. Sulfur burns to form sulfur dioxide which reacts with rain water to form sulfuric acid.

(i) Describe how the high temperatures in vehicle engines are another cause of acid rain.

.....
.....
..... [3]

(ii) Give **two** harmful effects of acid rain.

.....
..... [2]

(d) In 2010, a large coal-burning power station in the UK was converted to burn both coal and wood.

Explain why the combustion of wood rather than coal can reduce the effect of the emissions from this power station on the level of carbon dioxide in the atmosphere.

.....
.....
.....
..... [3]

[Total: 12]

07. 0620_s15_qp_33 Q: 4

(a) (i) Coal is a solid fossil fuel.

Name another fossil fuel.

..... [1]

(ii) Explain what is meant by the term *fossil fuel*.

.....
..... [2]

(b) The burning of fossil fuels is largely responsible for the formation of acid rain. Two of the acids in acid rain are sulfuric acid and nitric acid.

(i) Explain how the combustion of coal can form sulfuric acid.

.....
.....
..... [3]

(ii) High temperatures generated by the combustion of fossil fuels can lead to the formation of nitric acid. Explain.

.....
.....
..... [3]

(iii) Nitric acid contains nitrate ions.

Describe a test for nitrate ions.

.....
..... [2]

(iv) Explain how you could determine which one of two samples of acid rain had the higher concentration of hydrogen ions.

.....
..... [2]

[Total: 13]

14.2. FUELS

08.0620_s14_qp_31 Q: 3

(a) Different gases diffuse at different speeds.

(i) What is meant by the term *diffusion*?

.....
..... [1]

(ii) What property of a gas molecule affects the speed at which it diffuses?

..... [1]

(b) Helium is a gas used to fill balloons. It is present in the air in very small quantities. Diffusion can be used to separate it from the air.

Air at 1000 °C is on one side of a porous barrier. The air which passes through the barrier has a larger amount of helium in it.

(i) Why does the air on the other side of the barrier contain more helium?

..... [1]

(ii) Why is it an advantage to have the air at a high temperature?

.....
..... [1]

(c) Most helium is obtained from natural gas found in the USA. Natural gas contains methane and 7% helium. One possible way to obtain the helium would be to burn the methane.

(i) Write an equation for the complete combustion of methane.

..... [1]

(ii) Suggest why this would **not** be a suitable method to obtain the helium.

.....
..... [1]

(iii) Suggest another method, other than diffusion, by which helium could be separated from the mixture of gases in natural gas.

..... [1]

[Total: 7]

09. 0620_s14_qp_32 Q: 2

(a) Natural gas, which is mainly methane, is a fossil fuel.

(i) What is meant by the term *fuel*?

.....
..... [1]

(ii) Name **two** other fossil fuels.

..... [2]

(iii) Name a **solid** fuel which is not a fossil fuel.

..... [1]

(b) Fossil fuels are formed by the anaerobic decomposition of organic matter. Anaerobic means in the absence of oxygen.

(i) The organic matter contains hydrogen and carbon. Suggest the products that would be formed if the decomposition occurred in the presence of oxygen.

..... [2]

(ii) What are the **two** main disadvantages in the widespread use of fossil fuels?

.....
.....
..... [2]

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[Total: 8]

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10.0620_s13_qp_31 Q: 1

Petroleum contains hydrocarbons which are separated by fractional distillation.

(a) (i) Complete the following definition of a hydrocarbon.

A hydrocarbon is a compound which
..... [2]

(ii) Explain what is meant by the term *fractional distillation*.

.....
.....
..... [2]

(b) Some of the fractions obtained from petroleum are given below.
State a use for each fraction.

bitumen

lubricating fraction

paraffin fraction

gasoline fraction

[4]

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[Total: 8]

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01. 0620_m20_ms_42 Q: 1

(a)	distillation (1) fractional (1)	2
(b)	naphtha (1) bitumen (1)	2
(c)(i)	any two from: methane ethane propane	2
(c)(ii)	$2C_4H_{10} + 13O_2 \rightarrow 8CO_2 + 10H_2O$ CO ₂ and H ₂ O as products (1) correct equation (1)	2
(c)(iii)	carbon monoxide	1
(d)(i)	kerosene is more viscous gasoline is more flammable	2
(d)(ii)	kerosene has molecules with a longer carbon chain	1
(e)	hydrogen + oxygen → water	1

02. 0620_s19_ms_42 Q: 1

(a)	methane	1
(b)	oxygen	1
(c)	aluminium oxide	1
(d)	oxygen	1
(e)	methane	1
(f)	silicon(IV) oxide	1

03. 0620_m18_ms_42 Q: 1

(a)(i)	A	1
(a)(ii)	M1 C M2 D	2
(a)(iii)	D	1
(a)(iv)	B	1
(a)(v)	M1 F M2 B	2
(a)(vi)	M1 G M2 H	2
(b)(i)	a shared pair of electrons (between two atoms) M1 shared electrons M2 pair of / two electrons	2
(b)(ii)	M1 three correct bonding pairs from one N atom to each of three F atoms M2 (3 pairs of) non-bonding electrons on each of three F atoms to complete an octet M3 (1 pair of) non-bonding electrons on N atom to complete an octet	3
(c)(i)	two (or more) substances not chemically combined	1
(c)(ii)	21(%)	1
(c)(iii)	fractional distillation of liquid air M1 air is made into a liquid M2 (allow air to) boil or evaporate M3 condense the vapours / collect the vapours in order (of evaporation) fractional distillation gets M2 and M3	3
(c)(iv)	boiling points	1

04. 0620_s18_ms_42 Q: 1

(a)	distillation	1
(b)	electrolysis	1
(c)	filtration	1
(d)	fractional distillation / fractionation	1
(e)	chromatography	1

05. 0620_w18_ms_41 Q: 1

(a)	Al / aluminium	1
(b)	CaCO ₃ / calcium carbonate	1
(c)	CH ₄ / methane	1
(d)	SO ₂ / sulfur dioxide	1
(e)	Cl ₂ / chlorine	1
(f)	CH ₄ / methane	1

06. 0620_s15_ms_31 Q: 1

(a)	Any two fossil fuels from: crude oil / petroleum; natural gas / methane; petrol / gasoline; kerosene / paraffin; diesel (oil) / gas oil; fuel oil; refinery gas / LPG; propane; butane;	2	I ethane / oil / naphtha / coal / gas R coke / bitumen / lubricating oil / wood
(b)	hydrogen, oxygen, nitrogen; All three for 2 marks two for 1 mark	2	A H, O, N I H ₂ , O ₂ , N ₂
(c)(i)	M1 oxygen and nitrogen (from air) react; M2 oxides of nitrogen OR nitrogen oxide(s) are formed; M3 nitrogen oxides formed react with water (to form acid);	3	A nitrogen combust for M1 R M1 if oxygen or nitrogen originate from the fuel A named oxide of nitrogen e.g. nitrogen dioxide A correct formulae A NO _x
(c)(ii)	Any two from: M1 lowers pH or acidifies lakes / rivers or kills fish; M2 changes composition of soils or reduces fertility of soil or reduces crop yields deforestation or kills crops / trees / plants / leaves; M3 attacks (limestone) buildings or statues; M4 attacks metal (structures) / bridges;	3	R 'global warming / greenhouse effect' R 'increases pH of lakes so kills fish' for M1 A removes nutrients / leaches the soil A alternative words for 'attacks' e.g. damages / reacts with / corrode / erode for M3 and M4 I rusting but A 'enhances rusting' for M4 I toxicity to humans
(d)	Any three from: M1 wood burns to produce (less) carbon dioxide; M2 trees (wood) take in carbon dioxide; M3 by photosynthesis; M4 wood is carbon neutral fuel;	3	

07. 0620_s15_ms_33 Q: 4

(a)(i)	Any one fossil fuel from: crude oil / petroleum / natural gas / methane / petrol / gasoline / kerosene / paraffin / diesel (oil) / gas oil / fuel oil / refinery gas / LPG / propane / butane;	1	I ethane / oil / naphtha / coal / gas R coke / bitumen / lubricating oil / wood
(a)(ii)	(burn to) release energy; take a long time to form (from organic material);	2	If time stated 1000 years or more
(b)(i)	oxygen / air and sulfur (from fuel) react; (forms) sulfur (di)oxide; (sulfur dioxide) reacts with oxygen / air and water (to form sulfuric acid) OR sulfur trioxide reacts with water (to form sulfuric acid) OR sulfurous acid reacts with oxygen (to form sulfuric acid);	3	A correct formulae throughout A sulfurous acid if sulfur reacts with oxygen and water
(b)(ii)	oxygen and nitrogen react; making oxides of nitrogen; (oxides of nitrogen) react with water (making nitric acid);	3	A nitrogen combust R if oxygen or nitrogen originate from the fuel A named oxide of nitrogen A correct formulae A NO _x
(b)(iii)	add sodium hydroxide (solution) and aluminium; (warm) and ammonia made;	2	A zinc or Devarda's A description of smell of ammonia or test for ammonia

(b)(iv)	<p>M1 measure pH/describe how to measure pH (such as use universal indicator); M2 lower pH greater concentration of H⁺;</p> <p>OR M1 add Ca, Mg, Zn, Fe; M2 faster reaction greater concentration of H⁺ / faster bubbles or more hydrogen (in same time);</p> <p>OR M1 rate of reaction with (metal) carbonate; M2 faster reaction greater concentration of H⁺ / faster bubbles or more carbon dioxide (in same time);</p> <p>OR M1 electrical conductivity; M2 greater conductivity greater concentration of H⁺;</p> <p>OR M1 titrate with (named) alkali; M2 correct result;</p>	2	A M2 if non specified or other metal added in M1
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08.0620_s14_ms_31 Q: 3

- (a) (i)** (particles) spread to fill total available volume/move from high concentration to low concentration / moves down a concentration gradient (1) [1]
- (ii)** mass or M_r (1) [1]
- (b) (i)** helium atoms / molecules are lighter than molecules in air or N₂ **and** O₂
or helium is less dense than air or N₂ **and** O₂.
or helium diffuses (through the porous barrier) faster than air or N₂ **and** O₂. (1) [1]
- (ii)** faster rate of diffusion / molecules move faster (at high temperatures). (1) [1]
- (c) (i)** CH₄ + 2O₂ → CO₂ + 2H₂O (1) [1]
- (ii)** would get a mixture of helium and carbon dioxide
or would get a mixture of gases
or waste of methane/natural gas/fossil fuel (1) [1]
- (iii)** fractional distillation (1) [1]

[Total: 7]

(a) (i) substance / material / compound / element / mixture (burnt) to produce / release energy or heat (1) [1]

(ii) Any **two** from:

- coal
- coke
- peat
- petroleum / crude oil
- refinery gas / LPG
- gasoline / petrol
- naphtha
- kerosene / paraffin
- diesel (oil) / gas oil
- fuel oil
- propane
- butane

[2]

(iii) wood / charcoal / animal dung / biomass / Uranium / U / plutonium / Pu (1) [1]

(b) (i) any **two** from:

- water / steam / water vapour / H₂O (1)
- carbon dioxide / CO₂ (1)
- carbon monoxide / CO (1)

[2]

(ii) any **two** from:

- limited or finite resource / non-renewable / will run out / depleted (1)
- greenhouse effect / gas(es) / climate change / (cause) global warming (1)
- acid rain (1)
- production of poisonous / toxic gases (1)

[2]

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10. 0620_s13_ms_31 Q: 1

- (a) (i) contains carbon and hydrogen [1]
cond: only / just [1]
- (ii) (different) boiling points [1]
cond: separate [1]
- (b) bitumen-making roads / roofs / water-proofing, etc. [1]
- lubricating fraction – waxes / vaseline / grease, etc. or machinery example, e.g. (oil a) bike / hinges / reducing friction [1]
- paraffin fraction – jet fuel / (home) heating or tractors or cooking or lighting [1]
- gasoline fraction – petrol or fuel for cars / vans / trucks [1]

[Total: 8]

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